REMARKS/ARGUMENTS

In view of the foregoing amendments and the following arguments, reconsideration of the present patent application is respectfully requested. Claims 1, 7, 13 and 19 are amended for further distinguishing the present invention from the cited references. All of the amendments are fully supported by the specification of the present application as originally filed, and therefore there is no new matter added therein.

Rejection under 35 U.S.C. §103(b)

Claims 1-4 are rejected under 35 U.S.C. 103(b) as being anticipated by Amirdis et al., WO/9943610 in view of People's Republic of China Document No. 94112487.8 (PRCD 94112487.8). The applicant respectfully disagrees.

Regarding the presently amended independent Claim 1 of the present application, it recites a shell and tube reactor module for hydrogen production comprising a reactor having a shell side, **at least one palladium membrane tube** as a tubular section, and **a steam reforming catalyst section** in the shell side; and **a catalyst combustion section** having ***an oxidation catalyst*** dispersed on a supporting material and surrounding the steam reforming catalyst, wherein said at least one palladium membrane tube has one sealed end located at upstream of flowing path, and said oxidation catalyst is formed by **a noble metal with boron nitride**. Nevertheless, as to the shell and tube reactor module disclosed by Amiridis et al., it is found that Amiridis et al. only disclose a shell and tube reactor module for hydrogen production, comprising at least one metal alloy membrane tube surrounded by a bed of catalyst material, as described in Page 4 Lines 4-30, Page 5, Lines 1-30 and Figs. 1 and 4 of the Amiridis et al. reference. As emphasized by the applicant in the response submitted on September 19, 2006, the catalyst material used in the Amiridis et al. reference is a steam reforming catalyst for lowering the activation

energy of the steam reforming reaction, and such production of hydrogen by catalyzed steam reforming reaction with the metal alloy membrane tube is a well known technique, as mentioned in the respective technical backgrounds of the present application and the other cited references. Nevertheless, it is clear that the incorporation of the **catalyst combustion section** having an oxidation catalyst formed by a noble metal and boron nitride and dispersed on a supporting material and surrounding the steam reforming catalyst section, which is specifically recited in the presently amended Claim 1 of the present application, is a unique construction of the steam reforming reactor for smoothing the endothermic steam reforming reaction at a high reaction temperature.

Applicant respectfully disagrees with the Examiner's position that it would have been obvious to modify the device of the Amiridis et al. reference in view of the teachings of PRCD No. 94112487.8 to obtain the combination of features recited in Claim 1 of the present application. It is respectfully submitted that one skilled in the art would easily comprehend that the palladium disclosed in the PRCD No. 94112487.8 is used for purifying the generated hydrogen of the reactor module, as the function of the tube section recited in Claim 1, rather than as an oxidation catalyst for the catalyst combustion reaction. Nevertheless, to eliminate the possibility of confusing the oxidation catalyst for the catalyst combustion with the steam reforming catalyst, the claims 1 and 13 have been amended to recite that the oxidation catalyst is formed by **a noble metal with boron nitride,** thereby more clearly distinguishing the present invention from the cited references. All of the amendments can be supported by the embodiments (i.e., Examples 5-7), described in the specification.

In addition, the reactor module disclosed in the PRCD No. 94112487.8 is also heated by a heater 13, as shown in Fig. 2 of the PRCD No. 94112487.8, rather than by a catalyst combustion module. As emphasized by the applicant in the response submitted on September 19, 2006, the cited references, including the

Amiridis et al. reference and the PRCD No. 94112487.8, only disclose an ordinary heater surrounding the reactor, and it is clear to one skilled in the art that the ordinary heaters and the heater of catalyst combustion module, as recited in the claims of the present application, result in a novel and distinct reactor design and in different technical results. As to the ordinary heater disclosed in the cited references, it is difficult to provide the sufficient heat flux for the endothermic steam reforming reaction when the reactor is scaled up for practical application. It also could not allow a proper heat transfer for conduction to the center of the endothermic reactor for good control of the reaction temperature within the reactor. It is well known that the proper heat transfer to this endothermic reaction is as critical as the catalytic activity of the steam reforming catalyst converting the raw material to the hydrogen product.

Furthermore, the heater disclosed in the cited references must always be on the outside of the shell, since the external electrical energy must be supplied for generating the heat energy. On the other hand, the **catalyst combustion section** proposed in the present invention is not only applicable for the scale-up reactor, but also capable of being located inside of the shell of the reactor, since the catalyst combustion section is only the oxidation catalyst dispersed on a supporting material. It is respectfully pointed out that the **oxidation catalyst** for the catalyst combustion in the claimed invention is totally different from the steam reaction catalyst, since they are used for contributing to two different purposes, i.e. the heating and the lowering of the activation energy of the steam reforming reaction, respectively. In addition, the **catalyst combustion section** proposed in the present invention is able to recycle the exhaust gases generated during the steam reforming process in order to prevent the release of the incomplete reaction gases. Accordingly, it is clear that the technical features recited in the presently amended Claim 1 are not only distinct from those described in the Amiridis et al. reference, but also advantageous

thereover. Therefore, the applicant respectfully submits that claim 1 should be patentable over the Amiridis et al. reference.

Rejection under 35 U.S.C. §103(a)

Claims 7 and 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Amiridis et al., WO/9943610 in view of PRCD No. 94112487.8, Clawson et al., US Patent No. 6,648,480 and Willms, US Patent No. 5,525,322. This rejection is respectfully traversed. Regarding claim 13, as amended herein, the technical features recited therein substantially correspond to those recited in amended claim 1, except that the reactor is split into two reactor sections. As explained above, the technical features of amended claim 1 are patentable over Amiridis et al. and PRCD No. 94112487.8, taken singly or in combination. Furthermore, neither the Clawson reference nor the Willms reference mention how the thermal energy is transmitted to the endothermic reaction, nor do they describe the arrangement of the heating device. Accordingly, the applicant respectfully submits the technical features of claim 13, as amended, also cannot be taught or suggested by the cited references or by any combination thereof, nor may the advantageous features of the **catalyst combustion section** of the present invention be achieved thereby.

In addition, it is respectfully pointed out that a unique mirror-image concept, i.e. the splitting of the reactor into two mirror sections, of the membrane arrangement, as recited in amended claim 13, is used for complying with *the nature of hydrogen permeation with a palladium membrane having a permeation efficiency decreasing along the length of the membrane tube,* resulting in the declining of the hydrogen concentration and the membrane efficiency. Accordingly, the applicant respectfully submits such design is not only novel compared to those disclosed in the cited references, but also results in the unexpected results to one skilled in this art, and is therefore not obvious. Therefore, the applicant also respectfully submits that claim 13 is patentable over the cited references, taken singly or in combination.

As to the dependent Claims 2-4, 7, 9-12 and Claims 14-16, 19, 21-23, since both the independent Claims 1, and 13 are submitted to be patentable over the cited reference, the applicant respectfully submits that these dependent claims also should be allowable as being respectively dependent from allowable independent claims.

For the reasons set forth above, it is respectfully submitted that claims 1-4, 7, 9-16, 19, and 21-23, as amended, defined patentably over the art of record. Therefore, reconsideration and allowance of the present patent application are earnestly solicited at an early date.

Respectfully submitted,

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